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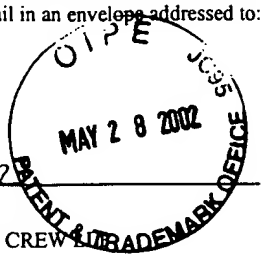
On May 10, 2002

TOWNSEND and TOWNSEND and CREW LLP

By: _____



PATENT
Attorney Docket No.: AM524R1/T289
TTC No.: 16301-028900

#37 Fuelle 6/3/02

COPY OF PAPERS ORIGINALLY FILED

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re application of:

KATSUYUKI MUSAKA et al.

Application No.: 09/187,551

Filed: November 5, 1998

For: METHOD FOR FORMING A THIN FILM FOR A SEMICONDUCTOR DEVICE

Examiner: Marianne Padgett

Art Unit: 1762

AMENDED APPELLANT'S BRIEF UNDER 37 CFR § 1.192

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

Applicants, in the above-captioned patent application, appeal the final rejection of claims 1-10, 27-29, and 31-34. The claims on appeal have been finally rejected pursuant to MPEP § 706.07(b). Accordingly, this appeal is believed to be proper. This appeal brief is filed in triplicate.

I. REAL PARTY IN INTEREST:

The real party in interest for the above-identified application is APPLIED MATERIALS, INC., a Delaware corporation having its principal place of business at P.O. Box 450A, Santa Clara, California 95052. The assignment is recorded in the U.S. Patent and Trademark Office on August 22, 1994 at Reel 7161/Frame 0321.

II. RELATED APPEALS AND INTERFERENCES:

This application is a reissue application of U.S. Patent No. 5,571,571, which issued from U.S. Patent Application No. 08/259,584, which was a continuation-in-part of U.S. Patent Application No. 08/184,331, filed January 19, 1994 (now abandoned).

An appeal is currently pending for U.S. Patent Application No. 08/888,499, which was a continuation of U.S. Patent Application No. 08/184,331. The present application is related to 08/888,499 via a terminal disclaimer.

III. STATUS OF CLAIMS:

Claims 1-10, 27-29, and 31-34 are pending.

Claims 1-10, 27-29, and 31-34 stand rejected as being based on a defective declaration under 35 U.S.C. § 251.

Claims 27-29 and 31-33 stand rejected under 35 U.S.C. § 251 as being an improper recapture of subject matter surrendered in the application for the patent upon which the present reissue is based.

Claims 27-29 and 31-34 stand rejected under 35 U.S.C. § 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventors, at the time the application was filed, had possession of the claimed invention. The Examiner alleges that claims 27-29 and 31-33 contain new matter. Claims 27-29 and 31-33 stand rejected under 35 U.S.C. § 251 as being based upon new matter added to the patent for which reissue is sought.

Claims 1-10 stand provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 29-33, 38-40, and 42-45 of copending Application No. 08/888,499. Applicants filed a terminal disclaimer on November 21, 2001 in response to this rejection.

Claims 27, 28, and 31 stand rejected under 35 U.S.C. § 102(b) or (e) as anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as obvious over Homma et al.

Claims 1-10, 27-29, and 31-34 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Nishiyama et al.

Claims 27-29 and 31-34 stand provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 29-33, 38-40,

and 42-45 of copending Application No. 08/888,499. Applicants filed a terminal disclaimer on November 21, 2001 in response to this rejection.

Claims 27-29 and 31-34 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over WO 92/20888 to Weise.

IV. STATUS OF AMENDMENTS:

Claims 1-10, 27-29, and 31-34 were rejected in the Office Action mailed October 31, 2000. The Examiner alleged that Applicants' statements based on Fig. 13 in the present application did not make sense and alleged that Fig. 13 was scientifically incorrect. In an Amendment filed on February 27, 2001, Applicants amended the claims and submitted a Declaration by Katsuyuki Musaka under 37 CFR § 1.132, which stated at ¶ 6:

> 6. Fig. 13 of the present Patent Application shows test results of C_2F_6 flow rate versus stress of the silicon oxide film obtained according to a method of the present Patent Application. Fig. 13 shows a reduction of the stress, which is a compressive stress of about $-1.25X10^9$ dyne/cm^2 at zero C_2F_6 flow, with higher C_2F_6 flow rates. The magnitude of the compressive stress decreases with an increase in the C_2F_6 flow rate. As seen in Fig. 13, the stress changes from negative (i.e., compressive) to positive (i.e., tensile) at about 450 sccm C_2F_6 flow rate. At a C_2F_6 flow rate of about 600 sccm, the stress becomes a tensile stress of about $0.4X10^9$ dyne/cm^2.

Claims 1-10, 27-29, and 31-34 were finally rejected in the Office Action mailed June 12, 2001. The Examiner alleges that the Declaration of Musaka contradicts the specification. Applicants filed a Response After Final under 37 C.F.R. § 1.116 on August 13, 2001. In the Advisory Action mailed September 4, 2001, the Examiner maintained the rejections.

In accordance with 37 C.F.R. § 1.192(c)(9), a copy of the claims involved in the appeal are contained in the Appendix attached hereto.

V. SUMMARY OF THE INVENTION:

Embodiments of the present invention provide a method of depositing conformal, high quality silicon oxide films over closely spaced, submicron lines and spaces without the formation of voids. The method comprises forming a plasma of tetraethylorthosilicate (TEOS) and a selected halogen-containing gas.

An embodiment of the present invention is directed to a method of forming a conformal thin film of silicon oxide on a substrate having spaced conductive lines thereon. The method comprises mounting a substrate onto a substrate support in a vacuum chamber. A plasma is formed in the vacuum chamber in a region above the substrate by means of an electrical power source from a reaction gas comprising a mixture of tetraethylorthosilicate and a fluorine-containing halocarbon gas selected from the group consisting of CY_4 and CX_3-$(CX_2)_n$-CX_3. X is hydrogen or halogen and n is an integer from 0 to 5 with the proviso that at least one X is fluorine and wherein Y is hydrogen or halogen and at least one Y is hydrogen and at least one Y is fluorine. The substrate is subjected to the plasma so as to deposit a layer of silicon oxide containing at least about 2.5 atomic percent of fluorine onto the substrate.

In accordance with another embodiment, a method of forming a layer of silicon oxide over a substrate having spaced conductive lines thereon in a process chamber comprises introducing a selected process gas comprising tetraethylorthosilicate and oxygen into the process chamber. A flow of a halogen source is added to the selected process gas at a flow rate previously determined to achieve a desired stress in the layer from a plasma enhanced reaction of the selected process gas and the flow of the halogen source at the flow rate. The desired stress in the layer is a tensile stress instead of a compressive stress in another layer formed from another plasma enhanced reaction of the selected process gas without the flow of the halogen source. The method comprises forming the layer with the desired tensile stress from the plasma enhanced reaction of the selected process gas and the flow of the halogen source at the flow rate.

In an example, Fig. 13 of the present application shows test results of C_2F_6 flow rate versus stress of the silicon oxide film obtained according to a method of the present Patent Application. Fig. 13 shows a reduction of the stress, which is a compressive stress of about $-1.25X10^9$ dyne/cm^2 at zero C_2F_6 flow, with higher C_2F_6 flow rates. The magnitude of the compressive stress decreases with an increase in the C_2F_6 flow rate. As seen in Fig. 13, the stress changes from negative (i.e., compressive) to positive (i.e., tensile) at about 450 sccm C_2F_6 flow rate. At a C_2F_6 flow rate of about 600 sccm, the stress becomes a tensile stress of about $0.4X10^9$ dyne/cm^2. Declaration of Musaka, ¶ 6.

VI. ISSUES:

The following issues are presented:

Whether claims 1-10, 27-29, and 31-34 are properly rejected as being based on a defective declaration under 35 U.S.C. § 251.

Whether claims 27-29 and 31-33 are properly rejected under 35 U.S.C. § 251 as being an improper recapture of subject matter surrendered in the application for the patent upon which the present reissue is based.

Whether claims 27-29 and 31-34 are properly rejected under 35 U.S.C. § 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventors, at the time the application was filed, had possession of the claimed invention.

Whether claims 27-29 and 31-33 are properly rejected under 35 U.S.C. § 251 as being based upon new matter added to the patent for which reissue is sought.

Whether claims 27, 28, and 31 are properly rejected under 35 U.S.C. § 102(b) or (e) as anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as obvious over Homma et al. (USP 5,288,518).

Whether claims 1-10, 27-29, and 31-34 are properly rejected under 35 U.S.C. §103(a) as being unpatentable over Nishiyama et al.

Whether claims 27-29 and 31-34 are properly rejected under 35 U.S.C. § 103(a) as being unpatentable over WO 92/20888 to Weise.

VII. GROUPING OF THE CLAIMS:

In the present case, the rejected claims do not all stand or fall together. Applicants submit that each claim presents distinct issues concerning patentability. In the interest of administrative economy and efficiency, however, Applicants agree to narrow the issues for the purposes of this appeal only by grouping the claims as follows:

Group 1: Claims 1, 6, and 7, which relate generally to a method of forming a conformal thin film of silicon oxide on a substrate having spaced lines thereon, wherein a plasma is formed in the vacuum chamber in a region above the substrate by means of an electrical power source from a reaction gas comprising a mixture of tetraethylorthosilicate and a fluorine-containing halocarbon gas selected from

the group consisting of CY_4 and CX_3-$(CX_2)_n$-CX_3. X is hydrogen or halogen and n is an integer from 0 to 5 with the proviso that at least one X is fluorine and wherein Y is hydrogen or halogen and at least one Y is hydrogen and at least one Y is fluorine;

Group 2: Claim 2, which is directed generally to the same subject matter as claim 1, but which includes the additional limitations that the plasma is created from the tetraethylorthosilicate and C_2F_6;

Group 3: Claims 3-5, which are directed generally to the same subject matter as claim 1, but which include the additional limitation that the plasma is created by means of two power sources having different frequencies;

Group 4: Claims 8-10, which relate generally to a method of forming a conformal thin film of silicon oxide over a substrate having spaced conductive lines thereon in a plasma chamber, wherein a plasma is formed from a plasma precursor gas vaporized tetraethylorthosilicate in a carrier gas including oxygen and a fluorocarbon selected from the group consisting of CY_4 and CX_3-$(CX_2)_n$-CX_3, wherein X is hydrogen or fluorine and n is an integer from 0 to 5 with the proviso that at least one X is fluorine and Y is hydrogen or halogen and at least one Y is hydrogen and at least one Y is fluorine, for depositing a layer of silicon oxide containing at least about 2.5 atomic percent of fluorine over the conductive lines;

Group 5: Claims 27 and 28, which relate generally to a method of forming a layer of silicon oxide over a substrate having spaced conductive lines thereon in a process chamber, wherein a selected process gas comprises tetraethylorthosilicate and oxygen into the process chamber, wherein a flow of a halogen source is added to the selected process gas at a flow rate previously determined to achieve a desired stress in the layer from a plasma enhanced reaction of the selected process gas and the flow of the halogen source at the flow rate, and wherein the desired stress in the layer is a tensile stress instead of a compressive stress in another layer formed from another plasma enhanced reaction of the selected process gas without the flow of the halogen source;

Group 6: Claim 29, which is directed generally to the same subject matter as claim 27, but which includes the additional limitation that the fluorine source is selected from the group consisting of CF_4 and C_2F_6;

Group 7: Claim 31, which is directed generally to the same subject matter as claim 27, but which includes the additional limitation that the desired tensile stress is less than about $0.4X10^9$ dynes/cm^2 in magnitude;

Group 8: Claim 32, which is directed generally to the same subject matter as claim 31, but which includes the additional limitation that the fluorine source comprises C_2F_6;

Group 9: Claim 33, which is directed generally to the same subject matter as claim 27, but which includes the additional limitation that the selected process gas comprises a mixture of the tetraethylorthosilicate and a fluorine-containing halocarbon gas selected from the group consisting of CY_4 and CX_3-$(CX_2)_n$-CX_3, wherein X is hydrogen or halogen and n is an integer from 0 to 5 with the proviso that at least one X is fluorine, and wherein Y is hydrogen or halogen and at least one Y is hydrogen and at least one Y is fluorine; and

Group 10: Claim 34, which is directed generally to the same subject matter as claim 33, but which includes the additional limitation that the layer of silicon oxide contains at least about 2.5 atomic percent of fluorine over the conductive lines.

VIII. DISCUSSION OF THE REFERENCES RELIED UPON BY THE EXAMINER:

In rejecting the claims under 35 U.S.C. §§ 102(b), 102(e), and 103(a), the Examiner relied upon the following references:

1. Homma et al. (United States Patent No. 5,288,518)

Homma et al. discloses a chemical vapor deposition method for forming a fluorine-containing silicon oxide film by introducing a gaseous mixture of alkoxysilane or its polymers as a source gas with fluoroalkoxysilane added thereto into a reaction chamber and performing decomposition of the gaseous mixture to deposit the fluorine-containing silicon oxide film onto a substrate. Homma et al. notes that "the silicon oxide films produced according to the prior art have a strong internal tensile stress of about $1X10^9$ dyn/cm^2" (col. 1, lines 35-37). In one example, the method employed by Homma et al. reduced the internal

stress to "$2X10^8$ dyn/cm^2 which was lower by one order of magnitude than that of the prior art silicon oxide film of $1X10^9$ dyn/cm^2" (col. 3, lines 42-45).

2. Nishiyama et al. (United States Patent No. 5,429,995)

Nishiyama et al. discloses a method of manufacturing a semiconductor device, in which a silicon oxide film containing fluorine is formed by plasma CVD method using a source gas containing at least silicon, oxygen, and fluorine. Nishiyama et al. discloses the use of CF_4, ClF_3, and SiF_4 as the fluorine-containing compound in place of NF_3 (col. 7, lines 18-20).

3. Weise et al. (PCT Publication No. WO 92/20888)

Weise et al. discloses a process for reducing intrinsic stress and/or hydrogen content of a SiO_x film grown by chemical vapor deposition. The process is applicable to plasma-enhanced and electron cyclotron resonance chemical vapor deposition of silicon dioxide wherein a vapor phase etchant is introduced while growing the silicon dioxide film. Three gases are used. "To grow silicon dioxide, the first gas can comprise a silicon containing gas such as SiH_4, Si_2H_6, SiF_4, Si_2F_6, $SiCl_4$, SiH_2Cl_2 and organosilanes, the second gas can comprise a halogen gas such as NF_3, HF, SF_6, CF_4, C_2F_6, $C_2Cl_3F_3$, SF_6, Br_2, Cl, F_2 and I_2 and the third gas can comprise O_2, N_2O and CO_2." Page 9, lines 14-20. "The intrinsic stress reducing step can reduce the magnitude of the intrinsic stress in the film to below 200 MPa, preferably below 150 MPa and more preferably below 100 MPa." Page 9, lines 26-30.

IX. ARGUMENTS:

Applicants concede that claims 1-10, 27-29, and 31-34 are properly rejected as being based on a defective declaration under 35 U.S.C. § 251 due to the correction of additional defects or errors in the reissue after the filing of the application and the original reissue declaration. Under 37 C.F.R. § 1.175(b)(1), a supplemental oath/declaration will be required where the application is otherwise in condition for allowance. Applicants intend to file shortly a supplemental reissue oath/declaration pursuant to 35 U.S.C. § 251 prior to allowance.

Because all the claims do not stand or fall together, Applicants will present arguments for each claim group.

A. Claims 1-10

Claim Group 1

Claims 1, 6, and 7 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Nishiyama et al. The Examiner recognizes that Nishiyama et al. does not disclose the fluorine-containing halocarbon gases recited in claim 1, but alleges that it would have been obvious to substitute the claimed compounds for the CF_4 disclosed in Nishiyama et al.

Applicants respectfully submit that claims 1, 6, and 7 are patentable over Nishiyama et al. because, for instance, Nishiyama et al. does not teach or suggest forming a layer using a gas comprising tetraethylorthosilicate and a gas selected from the group consisting of CY_4 and CX_3-$(CX_2)_n$-CX_3, wherein X is hydrogen or halogen and n is an integer from 0 to 5 with the proviso that at least one X is fluorine, and wherein Y is hydrogen or halogen and at least one Y is hydrogen and at least one Y is fluorine. Nishiyama et al. discloses CF_4, ClF_3, or SiF_4, and is devoid of any suggestion for the recited compounds. The rejection relies on the benefit of hindsight.

The Examiner alleges that the claimed gas compositions and those listed in Nishiyama et al. "would have been expected to have analogous chemistry and to produce the same trend for [F]/stress effects, using routing [sic] experimentation to determine their desirable flow parameter, etc." The Examiner does not provide an explanation for the allegation, except that one of the gaseous F-containing compounds (CF_4) disclosed in Nishiyama et al. contains fluorine and carbon. Such a disclosure by itself does not suggest the claimed gas compositions. Significantly, Nishiyama et al. discloses that it is possible to use CF_4, ClF_3, or SiF_4 instead of NF_3 (col. 7, lines 16-20). This suggests that a variety of gaseous fluorine-containing compounds can be used and would not have motivated a person of ordinary skill in the art to develop the formula for the fluorocarbon as recited in the claimed invention.

Claim Group 2

Claim 2 stands rejected under 35 U.S.C. §103(a) as being unpatentable over Nishiyama et al. Applicants believe claim 2 is allowable for the same reasons that claim 1 is allowable. Claim 2 further recites that the plasma is created from the tetraethylorthosilicate and C_2F_6. Nishiyama et al. discloses only CF_4, and does not suggest the use of C_2F_6 in the claimed method. Therefore, claim 2 is patentable.

Claim Group 3

Claims 3-5 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Nishiyama et al. Applicants believe claims 3-5 are allowable for the same reasons that claim 1 is allowable. Claims 3-5 further recite that the plasma is created by means of two power sources having different frequencies. Nishiyama et al. does not suggest the use of two power sources with different frequencies using the claimed process gas. Accordingly, claims 3-5 are patentable.

Claim Group 4

Claims 8-10 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Nishiyama et al. Applicants respectfully submit that claims 8-10 are patentable over Nishiyama et al. because, for instance, Nishiyama et al. does not teach or suggest forming a layer using a gas comprising tetraethylorthosilicate and a gas selected from the group consisting of CY_4 and CX_3-$(CX_2)_n$-CX_3, wherein X is hydrogen or halogen and n is an integer from 0 to 5 with the proviso that at least one X is fluorine, and wherein Y is hydrogen or halogen and at least one Y is hydrogen and at least one Y is fluorine. Nishiyama et al. discloses only CF_4 and is devoid of any suggestion for the recited compounds. The rejection benefits from the exercise of hindsight.

The Examiner alleges that the claimed gas compositions are analogous to those listed in Nishiyama et al. As discussed above, however, Nishiyama et al. discloses it is possible to use CF_4, ClF_3, or SiF_4 instead of NF_3 (col. 7, lines 16-20), which would not have motivated a person of ordinary skill in the art to develop the formula for the fluorocarbon as recited in the claimed invention.

B. Claims 27-29 and 31-34

The Examiner's rejections of claims 27-29 and 31-34 are predicated on her obstinate belief that the arguments concerning the various stresses do not make sense, and that the Declaration of Musaka is contradicted by the specification. The Examiner alleges that the Declaration of Musaka submitted with the Amendment dated February 27, 2001, contradicts the specification. The Examiner points to column 6, lines 43-45: "The compressive stress of the above film was found to be $1X10^9$ dynes/cm^2." The Examiner alleges that this statement infers the a positive stress is compressive and a negative stress is tensile.

The Examiner's reasoning is flawed. The $1X10^9$ dynes/cm^2 is a stress magnitude. Because the statement already refers to the stress as a compressive stress, there is no need to insert a negative sign in front of the magnitude. The insertion of a sign would be necessary, for instance, in a mathematical equation to distinguish between tensile (positive) stress and compressive (negative) stress for mathematical consistency. When the statement identifies the stress as a compressive stress, all is needed is the magnitude to fully describe the stress, and no negative sign is necessary.

In addition, the Examiner believes that the change of the stress from negative values to positive values in Fig. 13 is scientifically incorrect. In Fig. 13, the stress in the layer is a compressive stress of about $-1.25X10^9$ dyne/cm^2 at zero C_2F_6 flow rate. The magnitude of the compressive stress decreases with an increase in the C_2F_6 flow rate. The stress changes from negative (i.e., compressive) to positive (i.e., tensile) at about 450 sccm C_2F_6 flow rate. At a C_2F_6 flow rate of about 600 sccm, the stress is a tensile stress of about $0.4X10^9$ dyne/cm^2. Declaration of Musaka, at ¶ 6. The Examiner alleges that the values should not be negative, but just down an order of magnitude. The Examiner apparently confuses a regular scale which is used in Fig. 13 with a logarithmic scale which would be used to represent changes in orders of magnitude. There is nothing scientifically incorrect about a change in the stress from compressive to tensile going through a zero stress state as the process conditions are altered, such as the change in the gas flow rate shown in Fig. 13.

The Examiner's fixation on her belief that the stress diagram in Fig. 13 is somehow defective leads her to conclude that the inventor himself, who had over 13 years of industry experience and was involved in the experiments that led to the results presented in this application, lacks the competence to tell the difference between a tensile stress and a compressive stress. The Examiner's position is untenable.

As stated in the Declaration of Musaka, ¶ 6, Fig. 13 of the present Patent Application shows a reduction of the stress, which is a compressive stress of about $-1.25X10^9$ dyne/cm^2 at zero C_2F_6 flow, with higher C_2F_6 flow rates, where the stress changes from negative (i.e., compressive) to positive (i.e., tensile) at about 450 sccm C_2F_6 flow rate. There is no contradiction between the specification and the Declaration of Musaka. The Examiner's belief has no basis.

1. Rejections Under Section 112, ¶ 1, and Based on Alleged New Matter

Claims 27-29 and 31-34 stand rejected under 35 U.S.C. § 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventors, at the time the application was filed, had possession of the claimed invention. Claims 27-29 and 31-33 stand rejected under 35 U.S.C. § 251 as being based upon new matter added to the patent for which reissue is sought. The Examiner alleges that the use of the term "tensile" stress in claim 27 introduces new matter because the specification only uses the terms "intrinsic" stress and "compressive" stress.

Applicants respectfully submit that the disclosure of the present application clearly teaches the addition of a flow of a halogen source to a selected process gas at a flow rate to achieve a desired tensile stress in the layer from a plasma enhanced reaction of the selected process gas and the flow of the halogen source at the flow rate instead of a compressive stress in another layer formed from another plasma enhanced reaction of the selected process gas without the flow of the halogen source. The specification discusses the presence of compressive stress in the film. At page 14, lines 28-30, the specification states that Fig. 13 shows a reduction of the stress, which is a compressive stress of about $-1.25X10^9$ dyne/cm^2 at zero C_2F_6 flow, with higher C_2F_6 flow rates. As shown in Fig. 13, the stress changes from negative (i.e., compressive) to positive (i.e., tensile) at about 450 sccm C_2F_6 flow rate. See Declaration of Musaka, at ¶ 6.

It has been long held that "*ipsis verbis* disclosure is not necessary to satisfy the written description requirement of section 112. Instead, the disclosure need only reasonably convey to persons skilled in the art that the inventor had possession of the subject matter in question." *Fujikawa v. Wattanasin*, 39 U.S.P.Q.2d 1895, 1904 (Fed. Cir. 1996) (citation omitted); *In re Alton*, 37 U.S.P.Q.2d 1578, 1584 (Fed. Cir. 1996) ("If a person of ordinary skill in the art would have understood the inventor to have been in possession of the claimed invention at the time of filing, even if every nuance of the claims is not explicitly described in the specification, then the adequate written description requirement is met."). The disclosure of the tensile stress is clear to a person of ordinary skill in the art. Disclosure of the tensile stress in the form of Fig. 13 is adequate. "To meet the requirement of § 112, the patent

application need not utilize any particular form of disclosure." *Emory Univ. v. Glaxo Wellcome Inc.*, 44 U.S.P.Q.2d 1407, 1412 (N.D. Ga. 1997). Thus, the claims comply with 35 U.S.C. § 112. Because the change of the stress from compressive to tensile by introducing adequate flow of halogen source is clearly disclosed, the claims do not introduce new matter.

The disclosure is objected to based on alleged informalities directed to the negative stress values in Fig. 13 which the Examiner believes to be scientifically incorrect. In Fig. 13, the stress in the layer is a compressive stress of about $-1.25X10^9$ dyne/cm^2 at zero C_2F_6 flow rate. The magnitude of the compressive stress decreases with an increase in the C_2F_6 flow rate. The stress changes from negative (i.e., compressive) to positive (i.e., tensile) at about 450 sccm C_2F_6 flow rate. At a C_2F_6 flow rate of about 600 sccm, the stress is a tensile stress of about $0.4X10^9$ dyne/cm^2. Declaration of Musaka, at ¶ 6.

The Examiner alleges that the values should not be negative, but just down an order of magnitude. The Examiner apparently confuses a regular scale which is used in Fig. 13 with a logarithmic scale which would be used to represent changes in orders of magnitude. There is nothing scientifically incorrect about a change in the stress from compressive to tensile going through a zero stress state as the process conditions are altered, such as the change in the gas flow rate shown in Fig. 13. The Examiner's objections have no basis.

The Examiner continues to focus on her unfounded belief that it is impossible for the stress to change from compressive to tensile. This leads her to disregard the Declaration of Musaka who had over 13 years of industry experience and was involved in the experiments that led to the results presented in this application.

For at least the foregoing reasons, Applicants believe the claims comply with 35 U.S.C. § 112, and do not introduce new matter.

2. Rejection for Alleged Recapture

Claims 27-29 and 31-33 stand rejected under 35 U.S.C. § 251 as being an improper recapture of subject matter surrendered in the application for the patent upon which the present reissue is based.

Applicants note that the addition of claims 27-29 and 31-33 does not violate the recapture rule. MPEP 1412.02 states:

> Impermissible recapture occurs in a reissue where the claims in the reissue are of the same scope as, or are broader

> in scope than, claims deliberately canceled in an application to obtain a patent. Where such claims also include some narrowing limitation not present in the claims deliberately canceled in the application, the examiner must determine whether that narrowing limitation has a material aspect to it. If the narrowing limitation has a material aspect to it, then there is no recapture.

In this case, Applicants respectfully assert that independent claim 27 includes a narrowing limitation not present in the claims deliberately canceled in the application and that the narrowing limitation has a material aspect to it. The narrowing limitation in claim 27 is as follows:

> adding a flow of a halogen source to the selected process gas at a flow rate previously determined to achieve a desired stress in the layer from a plasma enhanced reaction of the selected process gas and the flow of the halogen source at the flow rate, the desired stress in the layer being a tensile stress instead of a compressive stress in another layer formed from another plasma enhanced reaction of the selected process gas without the flow of the halogen source; and
>
> forming the layer from the plasma enhanced reaction of the selected process gas and the flow of the halogen source at the flow rate.

The Examiner alleges that there is recapture because the recited stress and the concentration of fluorine are inherently related. MPEP 1412.02 states that "if the narrowing limitation is incidental, mere verbiage, or would be inherent even if not recited (in view of the specification), then the claims should be rejected under 35 U.S.C. 251." In this case, even assuming *arguendo* that the change of the stress in the layer were inherently related to the fluorine concentration, the formation of a layer at the flow rate selected to produce a tensile stress instead of a compressive stress in the layer would still not be incidental, mere verbiage, or inherent. Rather, the formation of a layer having a tensile stress by selecting an appropriate flow rate of the halogen source has a material aspect to it that was not previously surrendered or deliberately canceled and was not inherent in the previously examined claims.

The Examiner's rejection appears to be predicated on her belief that the arguments concerning the various stresses do not make sense, and that the Declaration of Musaka is contradicted by the specification. As discussed above, the Examiner's position is

untenable. As stated in the Declaration of Musaka, ¶ 6, Fig. 13 of the present Patent Application shows a reduction of the stress, which is a compressive stress of about $-1.25X10^9$ dyne/cm^2 at zero C_2F_6 flow, with higher C_2F_6 flow rates, where the stress changes from negative (i.e., compressive) to positive (i.e., tensile) at about 450 sccm C_2F_6 flow rate. There is no contradiction between the specification and the Declaration of Musaka.

Moreover, it is well settled that where a reissue claim does not attempt to protect the surrendered subject matter, it does not violate the recapture rule even though it may not include the substance of amendments that were made to gain allowance. *B.E. Meyers & C. v. United States*, 56 U.S.P.Q.2d 1110, 1116 (Ct. Cl. 2000). "The subject matter protected in the new independent reissue claims dealt only with the lens system; it had nothing to do with any type of pulsing circuitry." *Id.* As a result, the court found no violation of the recapture rule.

This case is analogous to *B.E. Meyers*. Claims 27-29 and 31-33 do not attempt to protect the surrendered subject matter, but are directed to a separately patentable aspect of the invention. More specifically, new independent claim 27 is directed to adding a flow of a halogen source to achieve a desired stress in the layer which is a tensile stress instead of a compressive stress that would other wise result without the flow of the halogen source. Claim 27 has nothing to do with forming a plasma in the vacuum chamber in a region above the substrate by means of an electrical power source from a reaction gas comprising a mixture of tetraethylorthosilicate and a specific type of fluorine-containing halocarbon gas and subjecting the substrate to the plasma so as to deposit a layer of silicon oxide containing at least about 2.5 atomic percent of fluorine onto the substrate without the formation of voids in the film.

For at least the foregoing reasons, Applicants respectfully submit there is no recapture of subject matter surrendered in the application for the patent upon which the present reissue is based.

3. Rejections Based on Prior Art

Claim Group 5

Claims 27 and 28 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Nishiyama et al. or Weise et al. Claims 27 and 28 are further rejected under 35 U.S.C. §

102(b) or (e) as anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as obvious over Homma et al.

Applicants respectfully contend that claims 27 and 28 are patentable over the references because, for instance, they do not disclose or suggest adding a flow of a halogen source to the selected process gas at a flow rate previously determined to achieve a desired stress in the layer which is a tensile stress instead of a compressive stress in another layer formed without the flow of the halogen source. There is nothing in the references that suggests the recited features.

Generating a tensile stress instead of a compressive stress in a layer by adding a flow of a halogen source is illustrated, for instance, in Fig. 13. In Fig. 13, the halogen source is C_2F_6. The stress in the layer is a compressive stress of about $-1.25X10^9$ dyne/cm^2 at zero C_2F_6 flow rate. The magnitude of the compressive stress decreases with an increase in the C_2F_6 flow rate. At a C_2F_6 flow rate of about 600 sccm, the stress becomes a tensile stress of about $0.4X10^9$ dyne/cm^2. Nothing in the cited art discloses or suggests adding a flow of a halogen source to a selected process gas comprising tetraethylorthosilicate and oxygen to achieve a tensile stress, instead of a compressive stress in another layer formed using the selected process gas without the flow of the halogen source.

The Examiner's rejection is predicated on her obstinate belief that the arguments concerning the tensile stress do not make sense, and that the Declaration of Musaka is contradicted by the specification. As stated in the Declaration of Musaka, ¶ 6, however, Fig. 13 of the present application shows a reduction of the stress, which is a compressive stress of about $-1.25X10^9$ dyne/cm^2 at zero C_2F_6 flow rate, with higher C_2F_6 flow rates, where the stress changes from negative (i.e., compressive) to positive (i.e., tensile) at about 450 sccm C_2F_6 flow rate. There is no contradiction between the specification and the Declaration of Musaka. Accordingly, clams 27 and 28 are novel and patentable.

Claim Group 6

Claim 29 is rejected under 35 U.S.C. §103(a) as being unpatentable over Nishiyama et al. or Weise et al.

Applicants believe claim 29 is allowable for the same reasons that claim 27 is allowable. Claim 29 further recites that the fluorine source is selected from the group

consisting of CF_4 and C_2F_6. Neither Nishiyama et al. nor Weise et al. suggest the use of CF_4 or C_2F_6 in the recited method of forming the layer with a desired tensile stress instead of a compressive stress. Therefore, claim 29 is patentable.

Claim Group 7

Claim 31 is rejected under 35 U.S.C. §103(a) as being unpatentable over Nishiyama et al. or Weise et al. Claim 31 is further rejected under 35 U.S.C. § 102(b) or (e) as anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as obvious over Homma et al.

Applicants believe claim 31 is allowable over Nishiyama et al., Weise et al., and Homma et al. for the same reasons that claim 27 is allowable. Claim 31 further recites that the desired tensile stress is less than about $0.4X10^9$ dynes/cm^2 in magnitude. The references do not suggest the desired tensile stress instead of a compressive stress in the layer formed using the claimed method. Therefore, claim 31 is patentable.

Claim Group 8

Claim 32 stands rejected under 35 U.S.C. §103(a) as being unpatentable over Nishiyama et al. or Weise et al. Applicants believe claim 32 is allowable over Nishiyama et al. and Weise et al. for the same reasons that claim 27 is allowable. Claim 32 further recites that the fluorine source comprises C_2F_6. The references do not suggest the use of C_2F_6 in the method as claimed to achieve a tensile stress instead of a compressive stress in the layer. Accordingly, claim 32 is patentable.

Claim Group 9

Claim 33 stands rejected under 35 U.S.C. §103(a) as being unpatentable over Nishiyama et al. or Weise et al. Applicants believe claim 33 is allowable over Nishiyama et al. and Weise et al. for the same reasons that claim 27 is allowable. Claim 33 further recites that the selected process gas comprises a mixture of the tetraethylorthosilicate and a fluorine-containing halocarbon gas selected from the group consisting of CY_4 and CX_3-$(CX_2)_n$-CX_3, wherein X is hydrogen or halogen and n is an integer from 0 to 5 with the proviso that at least one X is fluorine, and wherein Y is hydrogen or halogen and at least one Y is hydrogen and at least one Y is fluorine. Neither Nishiyama et al. nor Weise et al. suggest the use of the recited process gas in the claimed method to achieve a tensile stress instead of a compressive stress in the layer. Therefore, claim 33 is patentable.

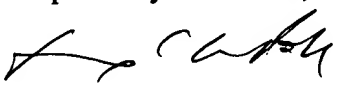
Claim Group 10

Claim 34 stands rejected under 35 U.S.C. §103(a) as being unpatentable over Nishiyama et al. or Weise et al. Applicants believe claim 34 is allowable over Nishiyama et al. and Weise et al. for the same reasons that claim 33 is allowable. Claim 34 further recites that the layer of silicon oxide contains at least about 2.5 atomic percent of fluorine over the conductive lines. Neither Nishiyama et al. nor Weise et al. suggest the use of the recited process gas in the claimed method to achieve a tensile stress instead of a compressive stress in the layer. Therefore, claim 34 is patentable.

X. CONCLUSION:

In view of the foregoing arguments distinguishing claims 1-10, 27-29, and 31-34 over the art of record, Applicants respectfully submit that the claims are otherwise in condition for allowance except for the lack of a supplemental reissue oath/declaration which is forthcoming prior to allowance, and respectfully request that the other rejections of these claims be reversed.

Respectfully submitted,



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Encl.: Appendix of claims involved in appeal

APPENDIX

1. A method of forming a conformal thin film of silicon oxide on a substrate having spaced conductive lines thereon comprising the steps of:

mounting a substrate onto a substrate support in a vacuum chamber;

forming a plasma in the vacuum chamber in a region above the substrate by means of an electrical power source from a reaction gas comprising a mixture of tetraethylorthosilicate and a fluorine-containing halocarbon gas selected from the group consisting of **[CX_4]** CY_4 and CX_3-$(CX_2)_n$-CX_3 wherein X is hydrogen or halogen and n is an integer from 0 to 5 with the proviso that at least one X is fluorine and wherein Y is hydrogen or halogen and at least one Y is hydrogen and at least one Y is fluorine; and

subjecting the substrate to the plasma so as to deposit a layer of silicon oxide containing at least about 2.5 atomic percent of fluorine onto the substrate without the formation of voids in the film.

2. The method of claim 1 wherein the plasma is created from the tetraethylorthosilicate and C_2F_6.

3. The method of claim 1 wherein the plasma is created by means of two power sources having different frequencies.

4. The method of claim 3 wherein the plasma is created by means of one power source having a frequency of about 13.56 MHz and a second power source having a frequency of between 50 KHz and 1000 KHz.

5. The method of claim 4 wherein the second power source has a frequency of about 400 KHz.

6. The method of claim 1 wherein a single power source having a frequency of about 13.56 MHz is used.

7. The method of claim 1 wherein said power source is a source of microwave power.

8. A method of forming a conformal thin film of silicon oxide over a substrate having spaced conductive lines thereon in a plasma chamber comprising

mounting a substrate in said chamber;

introducing into the chamber in a region above said substrate as a plasma precursor gas vaporized tetraethylorthosilicate in a carrier gas including oxygen and a fluorocarbon selected from the group consisting of

[CX_4] CY_4 and CX_3-$(CX_2)_n$-CX_3

wherein X is hydrogen or fluorine and n is an integer from 0 to 5 with the proviso that at least one X is fluorine and wherein Y is hydrogen or halogen and at least one Y is hydrogen and at least one Y is fluorine;

and thereafter forming a plasma therefrom, so as to deposit a layer of silicon oxide containing at least about 2.5 atomic percent of fluorine over said conductive lines.

9. A method according to claim 8 wherein the plasma precursor gas contains a ratio of silicon:fluorine of about 14:1.

10. A method according to claim 8 wherein the conductive lines are less than 1 micron in width and no more than 1 micron apart.

11.-26. CANCELED

27. A method of forming a layer of silicon oxide over a substrate having spaced conductive lines thereon in a process chamber, the method comprising:

introducing a selected process gas comprising tetraethylorthosilicate and oxygen into the process chamber;

adding a flow of a halogen source to the selected process gas at a flow rate previously determined to achieve a desired stress in the layer from a plasma enhanced reaction of the selected process gas and the flow of the halogen source at the flow rate, the desired stress in the layer being a tensile stress instead of a compressive stress in another layer formed from another plasma enhanced reaction of the selected process gas without the flow of the halogen source; and

forming the layer with the desired tensile stress from the plasma enhanced reaction of the selected process gas and the flow of the halogen source at the flow rate.

28. The method of claim 27 wherein the halogen source comprises a fluorine source.

29. The method of claim 28 wherein the fluorine source is selected from the group consisting of CF_4 and C_2F_6.

30. CANCELED

31. The method of claim 27 wherein the desired tensile stress is less than about $0.4X10^9$ dynes/cm^2 in magnitude.

32. The method of claim 31 wherein the fluorine source comprises C_2F_6.

33. The method of claim 27 wherein the selected process gas comprises a mixture of the tetraethylorthosilicate and a fluorine-containing halocarbon gas selected from the group consisting of CY_4 and CX_3-$(CX_2)_n$-CX_3, wherein X is hydrogen or halogen and n is an integer from 0 to 5 with the proviso that at least one X is fluorine, and wherein Y is hydrogen or halogen and at least one Y is hydrogen and at least one Y is fluorine.

34. The method of claim 33 wherein the layer of silicon oxide contains at least about 2.5 atomic percent of fluorine over the conductive lines.

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